Europäisches Patentamt
European Patent Office
Office européen des brevets

Bescheinigung Certificate Attestation

Die angehefteten Unterlagen stimmen mit der ursprünglich eingereichten Fassung der auf dem nächsten Blatt bezeichneten europäischen Patentanmeldung überein.

The attached documents are exact copies of the European patent application described on the following page, as originally filed.

Les documents fixés à cette attestation sont conformes à la version initialement déposée de la demande de brevet européen spécifiée à la page suivante.

Patentanmeldung Nr. Patent application No. Demande de brevet n°

02293109.1

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

R C van Dijk

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

Anmeldung Nr:
Application no.: 02293109.1
Demande no:

Anmeldetag:
Date of filing: 16.12.02
Date de dépôt:

Anmelder/Applicant(s)/Demandeur(s):

Koninklijke Philips Electronics N.V.
Groenewoudseweg 1
5621 BA Eindhoven
PAYS-BAS

Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
Si aucun titre n'est indiqué se referer à la description.)

Apparatus having an optical head for reading and/or writing data stored in an optical carrier and method involved in this apparatus

In Anspruch genommene Priorität(en) / Priority(ies) claimed /Priorité(s) revendiquée(s)
Staat/Tag/Aktenzeichen/State/Date/File no./Pays/Date/Numéro de dépôt:

Internationale Patentklassifikation/International Patent Classification/
Classification internationale des brevets:

G11B7/00

Am Anmeldetag benannte Vertragstaaten/Contracting states designated at date of filing/Etats contractants désignées lors du dépôt:

AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LI LU MC NL PT SE SI SK

The present invention relates to an apparatus including an optical head for reading and/or writing data in an optical carrier having a circular form, comprising tracks wound round the center of the carrier, this apparatus comprising:

- an optical mounting constituting said head for providing a light spot onto the carrier, having a main light path direction defined from the direction of the light emitted by a first laser device and/or from reflecting mirror devices, and an output pupil
- a moving part for moving said optical head in a moving direction which is normal to the tracks, the light path direction and the moving direction forming an angle for an adequate light intensity at the level of said pupil.

This apparatus finds many applications, notably for data carriers constituted by optical discs. For obtaining a good processing of the data, an usual requirement is that the light spot created from the laser must be perfectly defined.

The patent document WO 02/089126 discloses such an apparatus. Although this apparatus provides satisfaction, it has been deemed to improve it so that the requirement of the defined spot is satisfied without using extra materials.

The invention proposes an above-mentioned apparatus in which measures are provided to obtain a right spot easily. Moreover, the apparatus has the advantage that the optical head keeps a compact form without rooms wasting.

For this purpose, this apparatus includes an optical head for reading and/or writing data in an optical carrier having a circular form, comprising tracks wound round the center of the carrier, this apparatus comprises:

- an optical mounting constituting said head for providing a light spot onto the carrier, having a main light path direction defined from the direction of the light emitted by a first laser device and/or from reflecting mirror devices, and an output pupil
- a moving part for moving said optical head in a moving direction which is normal to the tracks, the light path direction and the moving direction forming an angle for an adequate light intensity at the level of said pupil.

The invention proposes also a method for reading and or writing an optical data carrier comprising the steps of:

- providing an angle between a main light path direction of an optical head and tracks which are fitted in it, so that to satisfy requirements for reading and or writing this optical data carrier.

It must be considered that this angle has almost no effect on the reading or writing spot when a beam shaper is applied, because it makes the asymmetric beam of the semiconductor laser more or less circular symmetric.

These and other aspects of the invention are apparent from and will be elucidated, by way of non-limitative example, with reference to the embodiment(s) described hereinafter.

Fig.1 shows an apparatus in accordance with the invention.

Fig.2 shows an optical head comprised in said apparatus according to the invention.

Fig.3 shows a first embodiment of an optical head according to the invention.

Fig.4 shows the proposed angle according to an aspect of the invention.

Fig. 5 is a diagram showing the light intensity for a DVD as a function of the angle.

Fig.6 is a diagram showing the light intensity for a CD as a function of the angle.

Fig.7 shows a construction on which the optical head is mounted

Fig.8 shows light intensity at the pupil level with regard to the spot on the track.

Fig.1 shows an apparatus in which a data carrier 1, notably an optical disc, is placed. The data carrier is shown in cross section. On this carrier, which is driven in a circular movement by a motor 3, an optical head 10, comprising a lens 12, focuses a laser light beam 14. This optical head 10 is placed in a moving part using a sledge16 for large displacements and using actuators (non shown on the figs.) for small displacements. The sledge 16 is moved thanks a motor 17. These displacements are performed in directions indicated by arrows 28. The signal OPT at the output of the unit 16 is applied to a signal distributor 27, which provides signals for a display unit 30 so that the content of disc can be displayed with some other information useful for the using of the apparatus. The distributor provides also other signals for the working of the apparatus.

The Fig.2 shows the optical head 10 in accordance with the invention. The head comprises a first diode laser 50. The light beam provided by this laser 50 is made circular by a beam shaper 52 which may be a dichroïc a polarizing type. The beam goes through the three spot grating 54 towards a dichroïc beam splitter 56. Advantageously, this beam splitter has a cubic form. At the output of the splitter 56, the beam is made parallel by a collimator lens 58 and it is reflected by a folding mirror 60 and afterwards, the polarization state is rotated 90° and changed into circular polarization by the $\lambda/4$ plate 62. The rim 63 delimits the output pupil. Finally the beam is focused by the objective lens 12. It must be noted that the elements 60, 62 and 12 have to be considered as rotated 90° into the plane perpendicular to the fig.

After reflection on the disc 1, the polarization of the beam is rotated 90° with regards to the original state by the plate 62. Then, the beam is directed to a detector 65 via the mirror 60, the lens 58 the cube 56 and another dichroïc beam splitter 67 and a servo lens 69

which is used for focusing spot on disc together with an electromechanical servosystem, during the working of the apparatus. The servo lens has a cylindrical surface for generating an extra astigmatism for the astigmatism focusing method and a negative spherical lens for focus adjustment. This lens might have some correction of the coma generated by the parallel plate 67. It is possible to define an optical axis of this head, for instance the light pass to the detector 65. It called XX' in this fig. This axis is perpendicular to the light path emitted by the laser 50 and 90.

In an advantageous way, the beam splitter 56 has a cubic form. Thanks this form, no undesired aberrations are generated on the transmitted CD beam and the polarizing is better than provided by the other splitters.

In a preferred embodiment, the invention proposes to combine another laser 90 in the same optical head 10. The light from this last laser 90 passes through a pre-collimator lens 92 for coupling enough power into the disc 1 and through a grating 94 for forming the three spots in the same way disclosed for the laser 50 and is directed to the cube-splitter 56 via the splitter 67. The path of the light is the same that for the other laser 50 till the detector 65.

The spot and light path orientation are coupled because of the polarizing properties of the laser and the beam splitters, when no extra polarization rational component are applied like a $\lambda/4$ plate. Such components increase the cost of the optical pick-up.

The fig.3 shows an exploded view of the head 10 in which the optical elements already mentioned are present. This is for a better understanding of the invention.

According to a feature of the invention, the axis XX' makes an angle with the moving direction YY' of the head as it is shown in fig.4. The YY' direction is perpendicular to the track as it shown for a given track 100. This axis may be met with the direction defined by the arrow 28. The determination of the angle ψ formed by XX' and YY' is made by considering the following.

In fig.5 and fig.6, the rim light intensity $R(\psi)$ on the pupil 63 depends of the angle ψ. The shown curves are given for a Gaussian laser beam. In the fig.5 concerning the laser 50 suited for the processing of DVD disc, the variation of the intensity is very small, when the beam shaper 52 is used. As the specifications concerning the DVD+RW require an rim intensity of 45-50° see the arrow 105 in this fig., the order of magnitude of the angle ψ is 45° too. So, the typical pupil and (the spot formed onto the disc) has to be in accordance to DVD+RW spot in the disc standard when the spot orientation is 45° with regard to the track on the disc. In fig.6 related to the rim light intensity of the laser 90 suited for the processing of CDR(W), the variations of this intensity is rather big.

The fig.7 shows, in a perspective view, the construction on which the head 10 is mounted. The reference 200 indicates bearings for shaft. These bearings are placed in the

direction YY', some elements of the head shown in this fig., are not visible because they are placed behind the construction. The axis XX' is given by the path of the light going to the detector 65.

The fig.8 shows the light intensity at the rim of the pupil 63 and the form of the spot 110 at the level of the track 100 on the disc 1. It must be noticed that the spot is DOS type (diagonal oval spot) which is required for reading /writing the CDR(W)

It must be added that for writing DVD recordable disc a round spot is required and therefore beam shaper is preferred. Consequently the spot orientation with respect to the tracks on disc is free.

The values are for this example:

Type of disc	Numerical Aperture of collimator	Laser Beam	Beam shaper magnification
DVD	0.14	9 ×22°	0.8×/1.64×
CD	0.135	9 ×17°	1×/1×

The DVD+RW standard asks a beam shaped and therefore almost round spot (fig.5). In detail, in the DVD+RW standard the light intensity at the rim of the pupil is given by 35 to 50% of the maximum intensity in the radial direction and 45 to 60% in the tangential direction. These limits can also be fulfilled with a beam shaped DOS. See black dots in fig.5. The spot and light path orientation are coupled because of the polarizing properties of the laser and the dichroic or polarizing beam splitter. The recording properties of are very sensitive for the spot shape and orientation.

For CDR(W) the standard is a on beam shaped DOS with rim intensities defined for the minimum as 57±5% for the highest intensity and 17±5% for the lowest intensity. The shape of the spot is oval with 45° orientation. This is closed to fig.6.

The advantages obtained by the measures of the invention are the following ones:

1- The astigmatism of the plane parallel plate fits two the desired direction : focus and push pull detection. The plate and cylinder lens astigmatism may have the same orientation or no cylinder lens is needed.

2- The orientation of the spot on disk will be a DOS (Diagonal Oval Spot) for CDR(W). This is the same as described in CDR(W) orange book high speed standard. Another orientation is possible when the plate is non-polarizing.

3- More efficient use of the foot print (space) for the optics.

4- Synergy in manufacturing equipment of standard CDR(W) and combining two lasers in an optical head.

5- No extra polarization rating components are needed like a $\lambda/4$ plate. Such components will increase the cost of the optical pick-up.

CLAIMS.

1- An apparatus including an optical head for reading and/or writing data in an optical carrier having a circular form, comprising tracks wound round the center of the carrier, this apparatus comprising:
- an optical mounting constituting said head, for providing a light spot onto the carrier, having a main light path direction defined from the direction of the light emitted by a first laser device and/or from reflecting mirror devices, and an output pupil,
- a moving part for moving said optical head in a moving direction which is normal to the tracks, the light path direction and the moving direction forming an angle for an adequate light intensity at the level of said pupil.

2- An apparatus as claimed in claim 1, wherein the order of magnitude of said angle is 45°.

3- An apparatus as claimed in claims 1 or 2, wherein said angle is given by a right illumination of said pupil according that a diagonal oval spot is required for a processing of data onto said carrier.

4- An apparatus as claimed in claims 1 to 3, suitable for optical carrier of DVD recordable type wherein the spot has a diagonal spot having a 45° orientation with regard to the track direction.

5- An apparatus as claimed in any claim 1 to 4 wherein a beam shaper is provided in the light path of the laser.

6- An apparatus as claimed in any claims 1 to 5 wherein a second laser device is provided.

7- A- method for reading and or writing an optical data carrier comprising the steps of:
- providing an angle between a main light path direction of an optical head and tracks which are fitted in it, so that to satisfy requirements for reading and or writing this optical data carrier.

8- An optical head suited for an apparatus as claimed in claims 1 to 6.

APPARATUS HAVING AN OPTICAL HEAD FOR READING AND/OR WRITING DATA STORED IN AN OPTICAL CARRIER AND METHOD INVOLVED IN THIS APPARATUS.

ABSTRACT.

This apparatus includes an optical head (10) for reading and/or writing data stored in an optical carrier (1) having a circular form, comprising tracks (100) wound round a center. this apparatus comprises , notably:

- an optical mounting constituting said head, having a main light path direction (XX') defined from the direction of the light emitted by a first laser device and/or from reflecting mirror devices, and an output pupil (63), including beam shaper (52),
- a moving part (16) for moving said optical head in a moving direction which is normal to the tracks (100), the light path direction and the moving direction forming an angle for an adequate light intensity at the level of said pupil.

This apparatus is well suited for reading and/ or writing CDRW and DVD

Fig.3

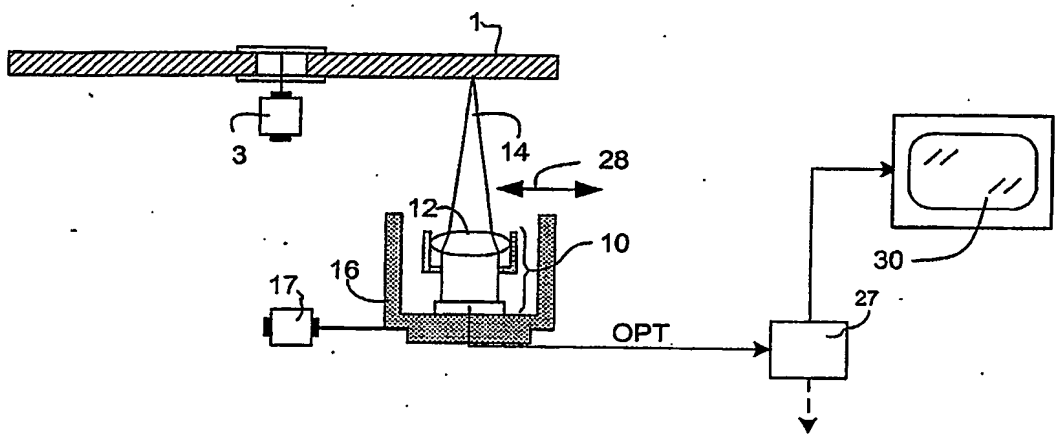
1
3
14
28
12
10
16
17
OPT
27
30

FIG.1

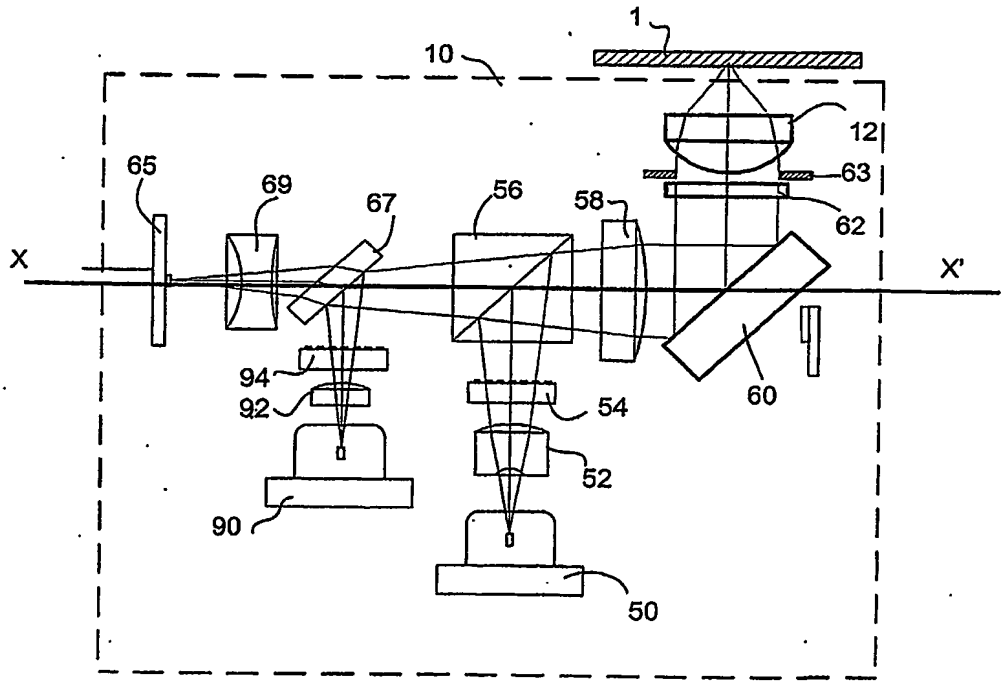
1
10
12
63
62
65
69
67
56
58
X
X'
94
92
54
60
52
90
50

FIG.2

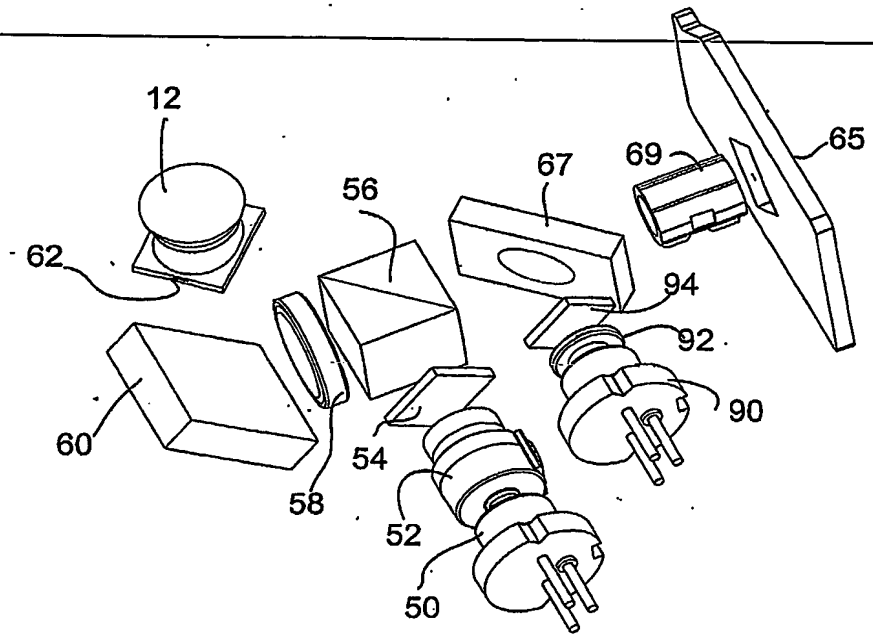

FIG.3

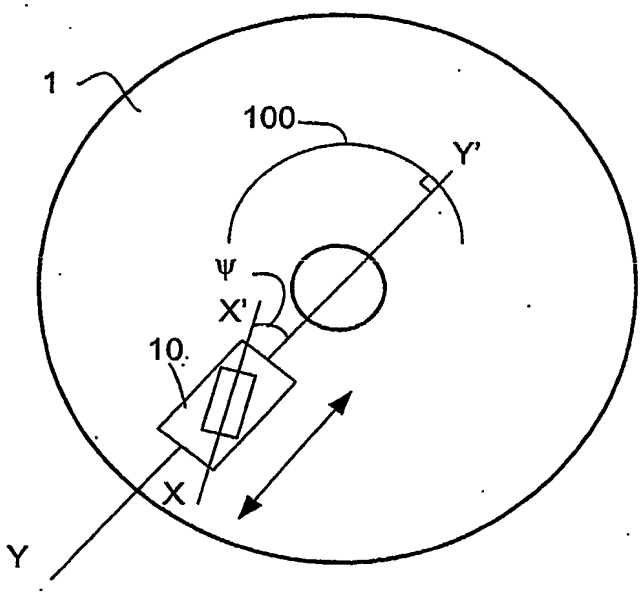

FIG.4

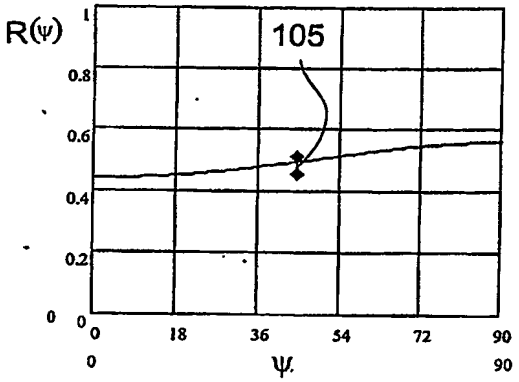
R(ψ)
1
0.8
0.6
0.4
0.2
0
105
0
18
36
54
72
90
ψ

FIG.5

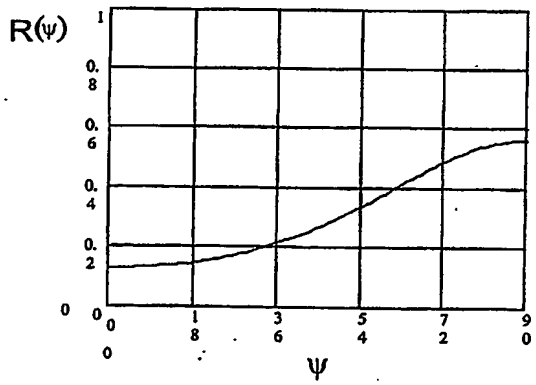
R(ψ)
1
0.8
0.6
0.4
0.2
0
0
18
36
54
72
90
ψ

FIG.6

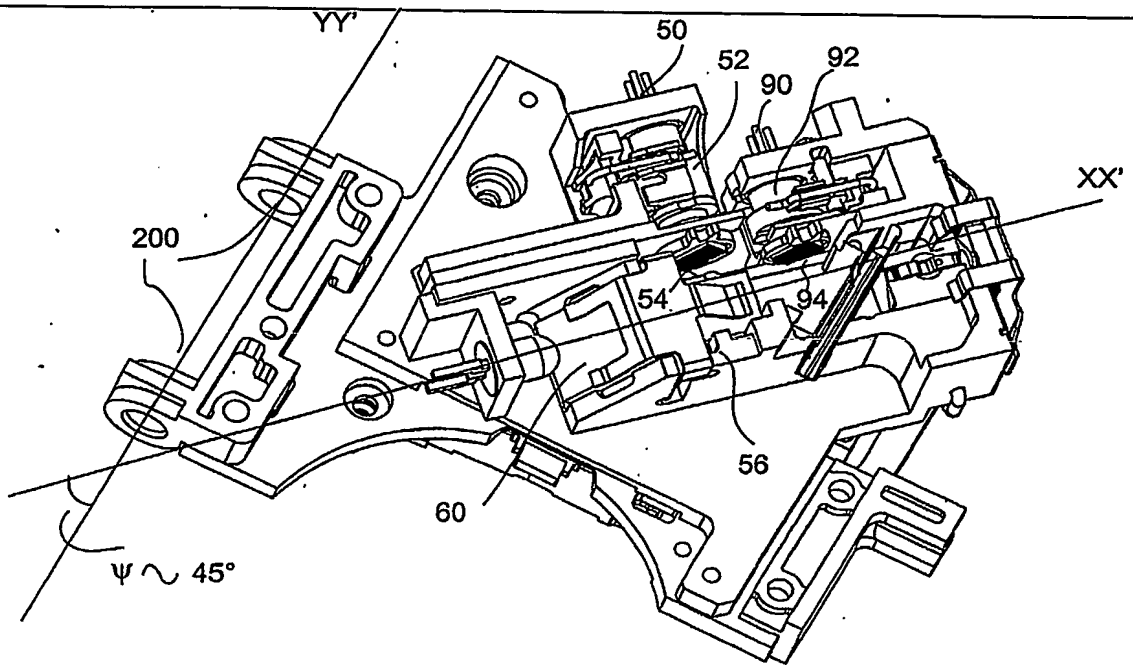

FIG.7

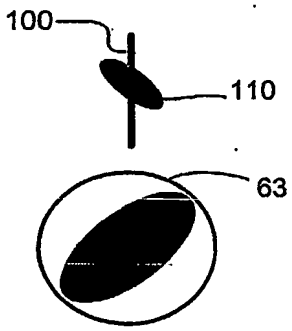

FIG.8